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CEL-DS11

OS0MP-A

OSCILLOSCOPE

1. GENERAL. This procurement requires a general-purpose, solid-state, dual-trace, 500 MHz oscilloscope with a dual time base and X-Y capabilities.

2. CLASSIFICATION. The equipment shall by Type III, Class 5, Style E, and Color R for Navy applications in accordance with MIL-T-28800.

3. OPERATIONAL REQUIREMENTS. The equipment shall be capable of operation within the accuracies, limits, and specifications identified below. A component oscilloscope system that consists of an oscilloscope mainframe, 3 vertical input amplifiers, and a dual time base will satisfy these requirements. An oscilloscope mainframe shall contain at least 2 vertical and 1 horizontal plug-in compartments.

3.1 Vertical system. The oscilloscope vertical system shall be provided with 3 vertical amplifiers as identified below.

3.1.1 Vertical modes. A vertical mode control shall allow selection of the following modes of operation.

a. Channel 1: Displays the channel 1 input signal only.

b. Channel 2: Displays the channel 2 input signal only.

c. Alternate: Displays channels 1 and 2 input signals alternately on consecutive sweeps.

d. Chop: Displays channels 1 and 2 by switching between channel inputs at a typical rate of 1 MHz.

e. Add: Displays the algebraic sum of channels 1 and 2 signal inputs.

3.1.2 Vertical amplifier (dc to 225 MHz). The equipment shall be provided with two identical, single-trace vertical amplifiers that have bandwidths from dc to at least 225 MHz. Selection between full bandwidth and a limited dc to 20 MHz {3 MHz bandwidth shall be provided. The amplifiers shall have provisions for inverting the polarity of the displayed signal and manually positioning the CRT trace.

3.1.2.1 Deflection factor. The deflection factor of the amplifiers shall be from 5 mV/div or less to at least 5V/div in selectable, calibrated steps. The accuracy shall be within {2%
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of the selected deflection factor. An uncalibrated control that is continuously variable between steps and extends the deflection factor to at least 12.5 V/div shall be provided.

3.1.2.2 Input RC. The input RC of the amplifier shall be 1 megohm {2% shunted by typically 20 pF.

3.1.2.3 Coupling. Operator control of ac and dc coupling and of ground reference shall be provided. When ac coupling is selected, the lower bandwidth limit shall be 10 Hz or less.

3.1.2.4 Maximum input overload protection. The input of the vertical amplifier shall be able to withstand the following voltages without damage:

a. DC coupled: 250V (dc + peak ac) when the ac component is 500V peak-to-peak maximum at a frequency of 1 kHz or less.

b. AC coupled: 500V (dc + peak ac) when the ac component is 500V peak-to-peak maximum at a frequency of 1 kHz or less.

3.1.2.5 Stability. The dc drift with ambient temperature (constant line voltage) shall not exceed 0.02 div/~C. The dc

drift with time (ambient temperature and line voltage constant) shall not exceed 0.02 div in any 1 minute after a 1-hour warm-up.

3.1.3 Vertical amplifier (dc to 500 MHz). The equipment shall be provided with a single-trace vertical amplifier that has a bandwidth from dc to at least 500 MHz. The amplifier shall have provisions for inverting the polarity of the displayed signal and manually positioning the CRT trace.

3.1.3.1 Deflection. The amplifier deflection factor shall be from 10 mV/div or less to at least 1 V/div in selectable, calibrated steps. The accuracy shall be within {3% of the selected deflection factor when driven from a 50 ohm source.

3.1.3.2 Input RC. The amplifier input RC shall be 50 ohms {1 ohm. The VSWR shall be less than 1.4 at 500 MHz.

3.1.3.3 Input coupling. Operator control of ac and dc coupling and of ground reference shall be provided. The lower bandwidth limit when ac coupling is selected shall be 1 kHz or less.

3.1.3.4 Maximum input. The input of the vertical amplifier shall be able to withstand 10 Vrms without damage.

3.1.3.5 DC stability. The dc drift with ambient temperature (constant line voltage) shall not exceed 400 V/~C.

3.2 Horizontal system. The horizontal system shall be provided with a dual time base and a means of operator selection of a normal sweep mode, intensified delaying sweep, delayed sweep, and alternate sweep mode.
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3.2.1 Delaying sweep. The delaying sweep rate shall be from 10 ns/div or less to at least 0.2 s/div in selectable, calibrated steps. An uncalibrated control that is continuously variable between steps shall be provided to extend the sweep rate to at least 0.5 s/div. The variable control shall be switchable between delaying and delayed sweeps.

3.2.1.1 Delaying sweep accuracy. The delaying sweep accuracy over the center eight major divisions of the CRT shall be within {0.3 CRT

divisions from 0.2s/div to 20 ns/div and within {0.4 CRT divisions for the 10 ns/div step.

3.2.1.2 Delay time multiplier. A delay time multiplier control shall allow continuous sweep delay from 0 to at least 9.8 times the delay time/div setting from 10 ns/div to 0.2 s/div (0 to 1.96 seconds).

3.2.1.3 Differential measurement accuracy. The differential delay time measurement accuracy is specified over the center eight major delay time multiplier divisions and within an temperature range of {15~C to +35~C. Full scale (fs) shall be defined as 10 times the time/div or delay time setting. This accuracy shall be within:

a. {(0.75% of measurement {0.25% fs) with sweep speeds of 0.1 s/div to 0.2 s/div and the start and stop delay time multiplier dial settings at 0.5 or greater.

b. {(0.75% of measurement {0.5% fs +5 ns) with sweep speeds of 0.1 s/div to 0.2 s/div and the start setting or the stop setting, or both, of the delay time multiplier dial at less than 0.5.

c. {(1% of measurement +0.5% fs) with sweep speeds of 10 ns/div to 50 ns/div and the start and stop delay time multiplier dial settings at 25 ns or greater.

d. {(1% of measurement {1% fs +5 ns) with sweep speeds of 10 ns/div to 50 ns/div and the start setting or the stop setting, or both, of the delay time multiplier dial at less than 25 ns.

3.2.1.4 Delay time jitter. With the delay time multiplier dial set to at least 0.2 div, the delay time jitter shall not exceed the following values.

a. 1 part in 50,000 of the maximum available delay time for time/div settings of 50 s/div to 0.2 s/div.

b. 1 part in 50,000 of the maximum available delay time {0.5 ns for time/div settings of 10 ns/div to 20 {s/div.

3.2.2 Main triggering. The equipment shall be provided with selectable main trigger modes of auto, HF sync, normal, and single sweep/reset. Selectable couplings of ac, ac-LF reject, .pa ac-HF reject, and dc shall be provided. Selectable trigger sources of internal, line, external, and external divided by 10 shall be provided.

3.2.2.1 Auto and normal mode sensitivity. The minimum signal required for triggering referenced to the following couplings shall be:

a. AC or AC-LF Reject Selected: 0.5 div internal or 100 mV external from 30 Hz to 20 MHz and 1 div internal or 500 mV external from 20 MHz to 500 MHz.

b. AC-HF Reject Selected: 0.5 div internal or 100 mV external from 30 Hz to 50 kHz.

c. DC Selected: 0.5 div internal or 100 mV external from dc to 20 MHz and 1 div internal or 500 mV external from 20 MHz to 500 MHz.

3.2.2.2 HF sync mode sensitivity. The triggering sensitivity shall be 0.5 div or greater internal or 100 mV external from 100 MHz to 500 MHz for all couplings except ac-HF reject.

3.2.2.3 Single sweep mode sensitivity. Single sweep mode triggering shall be as specified for the normal mode. The time base shall produce only one sweep when triggered and until reset.

3.2.2.4 Internal trigger jitter. The internal trigger jitter shall not exceed 50 ps at 500 MHz.

3.2.2.5 External trigger. The external trigger input impedance shall be selectable between 50 ohms {7% and a high impedance, typically 1 megohm shunted by 20 pF. The trigger level range shall be at least {3.5V in the external position and {35V in the external divided-by-10 position. The inputs shall withstand without damage 250V (dc + peak ac) for the 1 megohm input and 1W average for the 50 ohm input.

3.2.3 Delayed sweep. The delayed sweep rate shall be 0.5 ns/div or less to at least 0.2 s/div in selectable, calibrated steps. An uncalibrated control shall be continuously variable between steps and shall extend the sweep rate to at least 0.5 s/div.

3.2.3.1 Delayed sweep accuracy. The delayed sweep accuracy is specified over the center 8 divisions of the CRT throughout the operating temperature range and shall be within:

a. {3% doe 20 ns/div to 0.2 s/div.

b. {4% for 5 ns/div to 10 ns/div.

c. {5% for 1 ns/div to 2 ns/div.

d. {6% for 0.5 ns/div.

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3.2.3.2 Delayed trigger sensitivity. The delayed trigger shall have selectable ac and dc coupling. The triggering frequency range and sensitivity shall be identical to those of the respective coupling selections for the main triggering normal mode (see 3.2.2.1).

3.2.2.2 Delayed trigger jitter. The internal trigger jitter shall not exceed 50 ps at 500 MHz.

3.2.3.4 External delayed trigger input. The external delayed trigger input impedance shall be selectable between 50 ohms {7% and a high impedance, typically 1 megohm shunted by 20 pF. The trigger level range shall be at least {3.5V. The inputs shall withstand, without damage, 250V (dc + peak ac) for the 1 mehgohm input and 1W average for the 50 ohm input.

3.3 X-Y mode. The phase shift shall be within 2~ from dc to at least 35 kHz between the X and Y channels. The bandwidth shall be at least 1 MHz.

3.4 CRT display. The minimum CRT display area shall be 8 cm high by 10 cm wide with an internal, variable-illumination graticule ruled in 1 cm

squares with subdivisions of 0.2 division ruled on the cardinal axes.

3.4.1 CRT readout. An alphanumeric readout of the selected deflection factor and sweep rate shall be displayed on the CRT.

3.4.2 Automatic focus. Automatic focusing shall eliminate the need for manual focusing of the display with changes in intensity following an initial adjustment.

3.4.3 Beam finder. A beam finder control shall permit display centering while limiting the display to the graticule area.

3.5 Outputs.

3.5.1 Calibrator. A calibrator signal shall be provided through a front-panel connector that is compatible with the probes specified. The calibrator voltage shall be regulated to within {1% at 15~C to 35~C and when loaded by the vertical amplifiers identified. The calibrator square-wave signal shall have a rise time of 0.25 s or less and shall have protection from damage when grounded.

3.5.2 Sawtooth. A positive-going sample of the sawtooth signal from the horizontal time base shall be provided as an output.

3.5.3 Gate. A positive-going, rectangular waveform derived from the horizontal time base shall be provided as an output.

3.5.4 Signal. A sample of the selected vertical deflection signal shall be provided as an output.

3.5.5 Camera. Power, ground, and remote single-sweep access for use with a camera shall be provided.
3.5.6 Probe power. Connectors shall be provided to supply power for two active probe systems.

3.6 Probes. Three miniature, low-capacitance probes that have attenuation factors of 10X shall be provided and shall be compatible with the vertical amplifiers specified. One probe shall be supplied for use with the 500 MHz amplifier and two probes shall be supplied for use with the 225 MHz amplifiers.

4. SOURCE POWER. The equipment shall be powered in accordance with the nominal power requirements of MIL-T-28800 except operation from 400 Hz and 230V is not required. The maximum power required for operation shall not exceed 200 watts.

5. CALIBRATION INTERVAL. The calibration interval shall be 12 months minimum. The equipment model shall be within all accuracy requirements specified herein, with a 72% or greater confidence factor following a calibration interval of 12 months.

6. DIMENSIONS AND WEIGHT. The size and weight of the equipment shall be consistent with current commercial capabilities and shall not exceed the maximum dimensions for shipboard applications specified in MIL-T-28800. The weight shall not exceed 20 kg (44 lb).